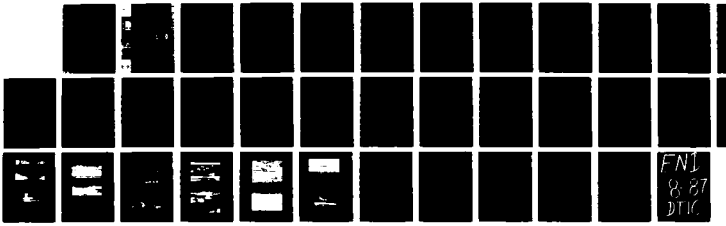
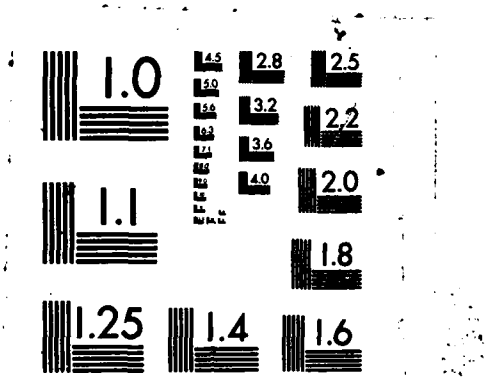
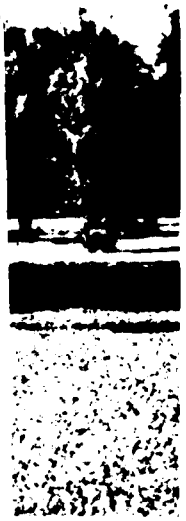
AD-A182 556 AQUATIC PLANT CONTROL RESEARCH PROGRAM: AN ECOLOGICAL STUDY OF HYDRILLA I..(U) FISH AND WILDLIFE SERVICE ANNAPOLIS MD R V FOLKER APR 87 WES/TR/A-87-1 1/1

UNCLASSIFIED F/G 8/1 NL







AQUATIC PLANT CONTROL RESEARCH PROGRAM

TECHNICAL REPORT A-87-1

AN ECOLOGICAL STUDY OF HYDRILLA IN THE POTOMAC RIVER; WATERFOWL SEGMENT

by

Robert V. Folker

Annapolis Field Office
US Fish and Wildlife Service
Annapolis, Maryland 21401

April 1987
Final Report

Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000

Monitored by Environmental Laboratory
US Army Engineer Waterways Experiment Station
PO Box 631, Vicksburg, Mississippi 39180-0631

Destroy this report when no longer needed. Do not return it to the originator.

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

ADA182556

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188
Exp Date Jun 30, 1986

1a REPORT SECURITY CLASSIFICATION: Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S): Technical Report A-87-1
6a. NAME OF PERFORMING ORGANIZATION: US Fish and Wildlife Service, Annapolis Field Office / 6b. OFFICE SYMBOL (If applicable)	7a NAME OF MONITORING ORGANIZATION: USAEWES Environmental Laboratory
6c. ADDRESS (City, State, and ZIP Code): Annapolis, MD 21401	7b ADDRESS (City, State, and ZIP Code): PO Box 631, Vicksburg, MS 39180-0631
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: US Army Corps of Engineers / 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code): Washington, DC 20314-1000	10 SOURCE OF FUNDING NUMBERS: PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11. TITLE (Include Security Classification)
An Ecological Study of Hydrilla in the Potomac River; Waterfowl Segment

12 PERSONAL AUTHOR(S)
Folker, Robert V.

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Final report	FROM _____ TO _____	April 1987	37

16 SUPPLEMENTARY NOTATION
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Hydrilla, Waterfowl, Potomac River

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

In an attempt to objectively evaluate the ecological role of hydrilla in the Potomac River, a qualitative study was conducted on the use of the plant by waterfowl species. Three study areas were selected along the river where hydrilla was known to grow profusely, and observations were made of waterfowl feeding on the hydrilla or otherwise using the areas. In addition, a small population of captive waterfowl was used in a simplistic study of feeding preference on hydrilla plant material collected along the river. This report gives the results of these studies.

In general, from the observations in these studies, it is apparent that hydrilla does provide ecological values important to waterfowl and other water-associated birds. The most obvious use of hydrilla by ducks and geese is direct consumption as food. Some duck species and other birds are no doubt obtaining adequate fish and invertebrate food items from the hydrilla stems, leaves, and interfoliar spaces.

(Continued)

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL	22b TELEPHONE (Include Area Code) / 22c OFFICE SYMBOL

19. ABSTRACT (Continued).

These studies, although qualitative for the most part, indicate that the ecological value of hydrilla is probably very well worth further consideration. The potential positive scientific information to be gained is obvious. Keywords: Aquatic weeds; aquatic plants; weed control

Accesion For	
NTIS CRA&I	☑
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and / or Special
A-1	

Preface

This report was prepared for the US Army Engineer District, Baltimore (NAB), by the US Fish and Wildlife Service (USFWS) through the US Army Engineer Waterways Experiment Station (WES) under Interagency Agreement Order No. WESRF85-109. Funds were provided by the NAB under appropriation number 96X4902, Revolving Fund, through the Aquatic Plant Control Research Program (APCRP) at the WES. Mr. E. Carl Brown of the Office, Chief of Engineers, was APCRP Technical Monitor.

The work reported herein was performed by Mr. Robert V. Folker and Ms. Linda Hurley, Annapolis Field Office (AFO), USFWS, Annapolis, Md., under the direct supervision of Mr. Glenn Kinser, Supervisor, AFO. Mr. Folker prepared this report. Technical supervisor at WES was Mr. Russell F. Theriot, Program Manager's Office, Environmental Laboratory (EL).

The author would like to acknowledge Messrs. Jackson Abbott and Edwin Wiegel for their waterfowl observations and reporting in the Hunting Creek-Belle Haven Marina areas; Mr. Roy Castle for his time and permission to use his captive waterfowl flock for the feeding experiments; and Dr. Matthew Perry for his efforts in conducting the waterfowl food habits analyses.

The work was conducted under the general supervision of Dr. John Harrison, Chief, EL. Mr. J. Lewis Decell was the WES Program Manager of APCRP. This report was edited by Ms. Jessica S. Ruff of the WES Information Products Division, Information Technology Laboratory.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

This report should be cited as follows:

Folker, R. V. 1987. "An Ecological Study of Hydrilla in the Potomac River; Waterfowl Segment," Technical Report A-87-1, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Contents

AN ECOLOGICAL STUDY OF HYDRILLA IN THE POTOMAC RIVER; WATERFOWL SEGMENT

Introduction

1. Hydrilla (*Hydrilla verticillata*) is a submerged aquatic macrophyte, native to Southeast Asia. Established in recent years in California, Florida, Georgia, and North and South Carolina (Steward et al. 1984), it was first discovered and positively identified in the Potomac River in 1982 (Rybicki et al. 1985).

2. Hydrilla is only one of many plant species known as submerged aquatic vegetation (SAV). SAV has been in decline in the Chesapeake Bay region in recent years, especially since the late 1960's (Stevenson and Confer 1978). A 1978–1981 survey conducted by the US Geological Survey found the tidal Potomac River to be "nearly devoid of submerged aquatic plants" (Rybicki et al. 1985). However, since 1983, numerous SAV species have returned to parts of the tidal Potomac. Along with hydrilla, two other species now reported, water stargrass (*Heteranthera dubia*) and spiny naiad (*Najas minor*), were previously unrecorded there.

3. The increasing SAV resources have led to speculation that water quality and environmental conditions were improving, at least in the Potomac. The presence of hydrilla, however, may not be beneficial because of its potentially explosive productivity and the possibility of its outcompeting more desirable indigenous SAV species. Hydrilla is considered a nuisance underwater plant elsewhere (Blackburn and Weldon 1969, Riemer 1984, Rybicki et al. 1985). Problems encountered include obstruction to boat passage as well as economic factors related to marina and other water-dependent facilities.

4. The importance of SAV to waterfowl is well known. Of the indigenous flora, certain species, such as sago pondweed (*Potamogeton pectinatus*), wildcelery (*Vallisneria americana*), and widgeongrass (*Ruppia maritima*) provide outstanding food values to a great many duck species (Martin, Zini, and Nelson 1951). Most of the work relating hydrilla with its value to wildlife, especially waterfowl, has taken place in Florida. In a study conducted on two central-Florida sites, hydrilla was determined to be the most important identifiable food found in esophagi and gizzard samples taken from 115 ducks

and coots (Montalbano, Hardin, and Hetrick 1979). In another Florida study (Montalbano, Hetrick, and Hines 1978), seven species of duck (112 birds) were collected over phosphatic clay-settling ponds and their esophageal contents identified and measured. Hydrilla was ranked among the top three plant food items consumed by these ducks based on aggregate volume or aggregate percentage. An investigation of waterfowl dispersion as related to plant communities on Lake Okeechobee, Florida, revealed that of the seven plant communities available, hydrilla ranked as the one most preferred (Johnson and Montalbano 1984). It was also evident from this work that hydrilla supported a higher diversity of waterfowl species.

5. Although many benefits are generally attributed to SAV, including food, protective habitat, nutrient uptake, buffering, and sediment trapping, it is not clear what ecological role hydrilla will play or what benefits hydrilla may offer the tidal Potomac. Because of this lack of information on the role of hydrilla, the US Army Engineer Waterways Experiment Station sponsored a qualitative ecological study conducted by the US Fish and Wildlife Service (FWS) in the spring and summer of 1985. In particular, use of hydrilla by fish, aquatic invertebrates, and waterfowl was to be investigated.

Study Area

6. The study area included three sites along the Potomac River south of Woodrow Wilson Bridge (Figure 1). The first site, Hunting Creek Bay, is located on the west side of the river, beginning about 300 yards (275 m) downstream of the bridge and extending south almost 1 mile (2 km) to Belle Haven Marina. This bay supported a luxuriant growth of hydrilla in 1985. The bed, which included minor amounts of three other SAV species, extended riverward to the edge of the navigation channel and covered an area of approximately 260 acres (105 ha).

7. Dyke Marsh is a relatively narrow strip of marsh, varying in width from about 500 to 1,600 ft (150 to 490 m), which parallels the western shore of the Potomac River. It extends downriver about 1.75 miles (2.8 km) from Belle Haven Marina. A mixed bed of SAV, dominated by hydrilla, grows in the open-water channels of Dyke Marsh.

8. The third site, Broad Creek Bay, is on the east shore of the river about 3 miles (5 km) downstream of the Bridge. It is a well-defined bay that

reaches inland about 1 mile (2 km) and covers an area of approximately 400 acres (160 ha). Broad Creek Bay supported a mixed bed of SAV in 1985.

Methods

9. Observations in the Hunting Creek Bay area were made from Hunting Creek Bridge, the Potomac River shoreline, and a boat. All observations in Broad Creek Bay were made from a boat, as this site was not easily accessed from shore. Observers used binoculars and variable-power telescopes to assist in bird identification.

10. An aerial survey of waterfowl within the study area was flown on 25 November 1985. Fred Roetker, a FWS biologist/pilot conducted the survey, assisted by one other observer. The plane's altitude and flight path were dictated by stringent requirements mandated by the Washington National Airport. This exacerbated the problems one normally encounters when conducting an aerial survey. The survey was flown at or below 500 ft (150 m).

11. Feeding tests, using hydrilla collected from the study area, were conducted on 8 and 31 October 1985. Captive waterfowl belonging to Mr. Roy Castle of Grasonville, Md., were employed in the tests. Mr. Castle has several enclosures around his house containing a mix of North American and exotic waterfowl. The enclosures were equipped with one or more small pools or troughs which the birds used for drinking and bathing. The birds are fed a dry commercial poultry mix that is readily available. Hydrilla, collected the day before and kept fresh in an ice chest, was placed in the troughs or on the ground. On two visits to Hunting Creek Bay, photographs of waterfowl, sandpipers, and other water-associated birds were obtained. An effort was made to get close-up photographs of birds feeding on hydrilla and concentrations of birds associated with the hydrilla bed.

12. Biologists collected waterfowl along the Virginia shore of the Potomac River on 3 days. Several areas in Dyke Marsh were used in this effort. The birds were collected over decoys with the use of shotguns, and trained hunting dogs were used in bird retrieval.

13. After each day's collecting was completed, the gullet and gizzard were excised from each bird, tagged, and placed in preservative. To forestall bacterial action and deterioration of ingested material, alcohol was introduced into the gullet of each bird as soon as it was collected. The food

habits analysis was conducted by personnel of the FWS Patuxent Wildlife Research Center.

Results

14. Fifteen species of waterfowl including nine species of dabbling ducks and five species of diving ducks were identified in the Hunting Creek Bay area during six visits covering the period from late September to mid-November 1985. Results of these observations are shown in Table 1. Birds were generally well dispersed throughout and along the edge of the hydrilla bed, which extended into the river for almost 1 mile (2 km). Consequently, it was often difficult to identify birds and determine species numbers. Estimates of some species such as Canada geese, which are larger and more visible, and scaup, ruddy ducks, and coots, which are often found in segregated flocks, were more readily obtainable. Individual species numbers varied considerably during the study period, with dabbling ducks peaking around the end of October and diving ducks appearing in good numbers toward the middle of November.

15. Observations of waterfowl and other water-associated birds in Hunting Creek Bay show that hydrilla is providing a valuable food resource to the Potomac River ecosystem. Waterfowl and coots were observed feeding on hydrilla. Shorebirds apparently were feeding on the small invertebrates associated with this plant, and it is quite likely that pied-billed grebes were feeding on the crustaceans, small fish, molluscs, and insects living on or close to this vegetation. At least 50 of these small grebes were noted on 25 October working in and close to the hydrilla bed. The highest 1-day count for this species in 1984 was eight, whereas only two were observed in 1983.

16. The results of waterfowl observations on Broad Creek Bay are given in Table 2. This appears to be a very high-quality area for waterfowl. As noted, it contains an excellent stand of mixed SAV that includes, in addition to hydrilla, Eurasian watermilfoil (*Myriophyllum spicatum*), water stargrass, coontail (*Ceratophyllum demersum*), spring naiad (*Najas guadalupensis*), and wildcelery.

17. Bird observations during an early October visit to this area were incidental to an attempt to gather late-season fish population data. At that time, several flocks of mallards totaling approximately 700 birds were

observed. Of interest was the fact that several of the mallard flocks were composed primarily of drakes. It seems likely that these birds were migrants, using Broad Creek Bay for a rest and feeding stop. By late October and into November, this Bay harbored a great many more ducks, including a substantial number of divers.

18. An estimate of the waterfowl population using this area was made on 14 November. This date must have coincided with a peak period of migration, as the number was between 8,000 and 10,000 birds. This figure was obtained by estimating numbers of birds in several flocks that had been flushed by our boat and were circling the Bay.

19. These observations were made about 1 week after the flooding which resulted from Hurricane Juan. Although the Potomac River was quite turbid, water in Broad Creek Bay was somewhat clearer. The SAV, much of it still attached to the bottom and several large mats which were free-floating, was still very abundant. It is possible that the better water clarity and abundance of food had a bearing on the concentration of waterfowl that was observed on this date in this area.

20. Results of waterfowl observations made by Messrs. Jackson Abbott and Edwin Wiegel in the Hunting Creek Bay area are summarized in Table 3. These data indicate that the study area experienced an increase in waterfowl numbers in 1985 as compared to 1984. Jackson's estimate of waterfowl numbers suggests that the increase was substantial (203 percent). Numbers of dabbling ducks were 462 percent higher. Wiegel's data indicate a more modest overall increase in waterfowl numbers of only 11 percent.

21. The disparities in the magnitude of waterfowl estimates by the two observers can be attributed to a variety of factors, including individual variation in the selection and employment of estimating techniques. However, the large difference in numbers of diving ducks observed, especially ruddy ducks, is more dependent upon how late in the year observations were made. The reasons for this difference can be attributed to two factors: (a) the diving duck migration period seemed to be later in 1985 than in 1984, peaking in the Hunting Creek Bay area after the middle of November, and (b) Wiegel concluded his observations on 13 November. Abbott's count of ruddy ducks on 23 November was more than twice that obtained by Wiegel 10 days earlier. Had Wiegel continued observing through November, it seems likely his 1985 estimate of diving ducks, as well as total waterfowl, would have been much higher.

22. Judging by Abbott's records of shorebird observation (Table 4), numbers of shorebirds using Hunting Creek Bay in 1985 were far greater than the previous year. The number of species observed increased by 60 percent, and total numbers were 600 percent higher in 1985.

23. Abbott and Wigel also noted a number of avian predators during their observations. Of most interest were a merlin and peregrine falcon that were active in the Hunting Creek Bay area for several days. They were probably attracted by the large population of available prey species, especially shorebirds.

24. The aerial survey flown in a fixed-wing aircraft on 25 November confirmed that about 5,600 ducks were still concentrated in the two areas selected for observation this fall (Table 5). While this seems to be a fairly impressive concentration of waterfowl, it is possible that this represents a conservative estimate, because of the problems associated with low-level flying in this area.

25. Birds seemed to be well dispersed along the shore between Hunting Creek and the south end of Dyke Marsh, making counting here somewhat easier. In Broad Creek Bay, waterfowl were concentrated down its center and out into the Potomac River. In both areas, much SAV was floating on the surface; in several places, beds of watermilfoil were visible.

26. Results of the feeding tests, using hydrilla collected on the study area, revealed that waterfowl responded positively to this plant. A small flock of Canada geese (Figure 2) had access to a small grassy area on which to feed in addition to the commercial mix that all the birds received. They began feeding on the hydrilla rather tentatively at first, but in about 15 min had consumed most of it. In the pen with the largest pool (Figure 3), black ducks, canvasbacks, and hooded mergansers were observed eating the plant, most of it floating in the pool. In another pen, containing mostly pintails and a few wood ducks (Figure 4), the pintails readily ate this plant, whether it was in the water or on the ground. The wood ducks did not attempt to feed on the hydrilla, perhaps unwilling to approach the feeding area while we were in the vicinity. They appeared to be very timid.

27. A fourth enclosure contained several geese, including two snows and a blue form of the snow goose, American shoveler, American wigeon, redheads, and a number of unidentified duck species. Most of the smaller waterfowl were rather timid and gave way to the larger geese and some of the more

aggressive exotics. It was difficult to observe normal bird feeding activity in this enclosure, as it was relatively small and rather crowded. Our presence in the pen definitely affected some of the birds, keeping them agitated and wary. Consequently, feeding behavior, except for the geese, was rather sporadic and furtive. All the identified waterfowl in this pen, with the exception of the redheads, were observed consuming hydrilla (Figure 5).

28. In 1984, a similar feeding experiment was conducted at the University of Maryland's Horn Point Laboratory by Frank Dawson, a Maryland Department of Natural Resources employee. Their captive flock included blue geese, snow geese, black ducks, mallards, gadwalls, pintails, canvasbacks, and redheads. According to Mr. Dawson, all of these species ate hydrilla.

29. It is obvious that these "trials" are simplistic. Nevertheless, captive waterfowl will consume hydrilla, and in some instances appear to have a strong enough preference to compete for it. However, it is not clear from these tests whether the birds are eating hydrilla because it is the only fresh green material available or whether this plant has other inherent qualities that make it attractive. It would seem that a better understanding of the value of hydrilla as a waterfowl food requires more in-depth investigation. One or more detailed studies could be expected to provide answers to a number of interesting questions, including: (a) What nutritional value does hydrilla have for waterfowl? (b) Are some parts of the plants more nutritious or more preferred than others? (c) Can waterfowl maintain normal vigor when fed an exclusive diet of hydrilla? and (d) Where would hydrilla rank as a duck food when compared with other species of SAV? Perhaps consideration should be given to funding some research to answer these questions.

30. In general, our efforts to obtain close-up photographs of waterfowl feeding on hydrilla in the wild were frustrated by the natural wariness of these birds. It is obvious, however, that large numbers of waterfowl were attracted to the hydrilla because of its own intrinsic food value and/or its ability to attract and support small invertebrate populations that may themselves serve as food. Every species of surface-feeding duck common to the east coast was recorded in the study area this fall. As the records and the photos indicate, most species occurred in abundance on or in close proximity to the hydrilla beds. Two species, the green-winged teal and wood duck, were not as closely identified with the hydrilla. Green-winged teal preferred to remain closer to shore feeding in very shallow water or unvegetated mudflats.

The wood duck also sought the river's edge where more woody or emergent herbaceous cover was available.

31. Figures 6-15 provide some direct evidence that ducks and geese found hydrilla an acceptable food source. It is not surprising that coot, possessing a well-documented preference for SAV, were feeding extensively on hydrilla. Pied-billed grebe, double-crested cormorant, great blue heron, and a number of shorebird species were observed wading in and feeding on or adjacent to hydrilla. It is well known that fish make up an important segment of the cormorant and heron diet, so the numbers of these birds using the edges and openings in the hydrilla may be indicative of a large fish population associated with this vegetation. Over 50 pied-billed grebes were counted during a 10-min interval, feeding near or in the hydrilla bed. While these birds also feed on small fish, they may have also been interested in the invertebrate population associated with hydrilla. Shorebirds (24 species were recorded on or adjacent to the Hunting Creek Bay hydrilla bed) seem to find the epifauna, and perhaps the epiphytes associated with hydrilla, a satisfactory food source.

32. The results of a food habits analysis conducted on 11 ducks, 1 Canada goose, and 1 coot are presented in Table 6. These data indicate that 8 of 11 ducks collected (72 percent) had been eating hydrilla. This plant was also consumed by seven of the nine mallards in our sample. The gizzards of five of these birds contained 100 percent hydrilla, while hydrilla composed 60 and 90 percent of the gizzard contents of the other two mallards. The only black duck collected had been feeding extensively on hydrilla.

33. The contents of the wood duck gizzard were composed entirely of smartweed (*Polygonum* spp.). The Canada goose had been feeding almost exclusively on grass, although its gizzard contained a trace amount of hydrilla. Observations of geese using the Hunting Creek Bay hydrilla bed exhibited behavior strongly indicating that they were feeding on hydrilla.

34. It was not surprising that the contents of the coot's gizzard was 90 percent hydrilla. From our 1985 observations, it can be inferred that their use of this plant was substantial.

Conclusions

35. The data gathered during the fall of 1985, especially concerning waterfowl, provide strong support that hydrilla has considerable ecological value for these birds. High numbers of species and birds were observed in the study areas.

36. In Hunting Creek Bay, birds were seen feeding in the hydrilla and, in some instances, it was obvious that mallards and coots were eating the plant. From the rough feeding trials conducted on a captive flock of waterfowl, it was determined that ducks and geese will eat hydrilla. In most cases, their feeding activity was enthusiastic and persistent.

37. Examination of ingested material taken from waterfowl collected in Dyke Marsh confirmed that waterfowl consumed hydrilla. The gizzards of 8 of the 11 ducks examined contained hydrilla. This plant was essentially the only material found in the gizzards of six of these birds.

38. Observations of waterfowl and other water-associated birds in Hunting Creek Bay by two experienced ornithologists indicated that bird numbers and species numbers recorded in 1985 were higher than in 1984. As the area in the Bay covered by hydrilla in 1985 was almost double that noted in 1984, a logical hypothesis is that this increase in bird use can be attributed to the increase in vegetation, particularly hydrilla.

39. Increased numbers of shorebirds and other water-associated birds were also recorded. Shorebird numbers tallied in 1985 were more than 500 percent higher than in 1984. Larger concentrations of great blue herons and double-crested cormorants were also evident. During a 1-day observation, 172 cormorants were recorded on Hunting Creek Bay, which is over 14 times as many as observed in the same area in 1984.

40. While it is not possible to make a 2-year comparison of waterfowl using the Broad Creek Bay area, estimated numbers of birds using the Bay were impressive, and it seems reasonable to assume that the availability of SAV, including hydrilla, was at least partially responsible for this concentration. This area should be watched closely in the future to assess possible changes in species composition of SAV and waterfowl response to these changes.

41. In summary, it is apparent from these observations that hydrilla does provide ecological values that are important to waterfowl and other water-associated birds. Based on our observations, the most obvious use of

hydrilla by ducks and geese is direct consumption as food. Some duck species and other water-associated birds are very likely obtaining adequate fish and invertebrate food items from hydrilla stems, leaves, and interfoliar spaces.

References

Blackburn, R. D., and Weldon, L. W. 1969. "USDA Technical Report on Controlling *Hydrilla verticillata*," Weeds, Trees, and Turf, Vol 8, pp 20-24.

Johnson, F. A., and Montalbano, F. 1984. "Selection of Plant Communities by Wintering Waterfowl on Lake Okeechobee, Florida," Journal of Wildlife Management, Vol 48, No. 1, pp 174-178.

Martin, A. C., Zini, H. S., and Nelson, A. L. 1951. American Wildlife and Plants - A Guide to Wildlife Food Habits, Dover Publications, Inc., New York.

Montalbano, F., Hardin, S., and Hetrick, W. M. 1979. "Utilization of Hydrilla by Ducks and Coots in Central Florida," Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Vol 33, pp 36-42.

Montalbano, F., Hetrick, W. M., and Hines, T. C. 1978. "Duck Foods in Central Florida Phosphate Settling Ponds," Proceedings of the Symposium on Surface Mining and Fish/Wildlife Needs in the Eastern United States, D. E. Samuel et al., eds., West Virginia University and US Fish and Wildlife Service, pp 247-255.

Riemer, D. N. 1984. Introduction to Freshwater Vegetation, AVI Publishing Company, Inc., Westport, Conn.

Rybicki, N. B., et al. 1985. "*Hydrilla verticillata* in the Tidal Potomac River, Maryland, Virginia, and the District of Columbia, 1983 and 1984," US Geological Survey, Openfile Report 85-77.

Stevenson, J. C., and Confer, N. M. 1978. "Summary of Available Information on Chesapeake Bay Submerged Vegetation," FWS/OBS-78/66, US Fish and Wildlife Service.

Steward, K. K., et al. 1984. "Hydrilla Invades Washington, D.C., and the Potomac," American Journal of Botany, Vol 71, No. 1, pp 162-163.

Table 1

Bird Observations on or Adjacent to the Hydrilla Beds Located Between Hunting Creek Bay and Belle Haven Marina, 24 September-14 November 1985

Common Name	24 Sep	10 Oct	17 Oct	25 Oct	30 Oct	14 Nov	Abundance	Percent Composition
Waterfowl								
Canada goose	9	200	--	60	6	47	322	16.2
Wood duck	*	5	--	--	--	--	5	0.25
Green-winged teal	--	--	50	--	--	--	50	2.5
American black duck	--	1	*	15	--	43	59	3.0
Mallard	*	100	75	100	20	9	304	15.3
Northern pintail	*	*	*	100	10	56	166	8.3
Blue-winged teal	*	150	*	2	--	--	152	7.6
Northern shoveler	*	6	--	3	--	5	14	0.7
Gadwall	--	--	--	2	--	--	2	0.1
American wigeon	--	--	*	35	--	--	35	1.8
Canvasback	--	--	--	--	--	2	2	0.1
Ring-necked duck	--	--	--	--	--	28	28	1.4
Lesser scaup	--	8	--	--	--	39	47	2.4
Common goldeneye	--	--	--	--	--	1	1	0.05
Ruddy duck	--	60	--	--	--	740	800	40.3
							1,987	100.0
Other water-associated birds								
American coot	--	--	0	--	600	170	770	61.2
Pied-billed grebe	*	--	12	50	--	11	73	5.8
Double-crested cormorant	100	--	50	200	--	40	390	31.0
Great blue heron	*	*	22	--	--	2	24	1.9
Great egret	--	*	--	--	--	--	--	--
Green-backed heron	--	--	1	--	--	--	1	0.07
							1,258	99.97
Shorebirds								
Black-bellied plover	*	*	--	--	--	--	--	--
Lesser golden plover	*	*	--	--	--	--	--	--
Semipalmated plover	*	*	*	--	--	--	--	--
Killdeer	*	--	--	--	--	--	--	--
Greater yellowlegs	*	*	1	1	--	--	2	3.9
Lesser yellowlegs	*	*	8	2	--	--	10	19.6
Spotted sandpiper	*	*	--	--	--	--	--	--
Hudsonian godwit	1	*	--	--	--	--	1	1.9
Ruddy turnstone	1	2	--	--	--	--	3	5.9
Sanderling	*	--	--	--	--	--	--	--
Semipalmated sandpiper	*	--	--	--	--	--	--	--
Least sandpiper	*	--	--	--	--	--	--	--
Pectoral sandpiper	*	*	15	20	--	--	35	68.6
Stilt sandpiper	*	--	--	--	--	--	--	--
Short-billed dowitcher	*	--	--	--	--	--	--	--
							51	99.9

* Species present but no actual count.

Table 2

Bird Observations on or Adjacent to the Mixed Bed of SAV Located in Broad Creek Bay, 7 October-14 November 1985

Common Name	7 Oct	30 Oct	14 Nov	Relative Abundance	Percent Composition
Waterfowl					
Tundra swan	--	1	1	1	<0.01
Brant	--	--	--	1	<0.01
Canda goose	--	375	--	375	2.9
Wood duck	--	--	--	--	--
Green-winged teal	--	--	--	--	--
American black duck	50	80	100	230	1.8
Mallard	700	300	700	1,700	13.2
Northern pintail	85	150	350	585	4.5
Blue-winged teal	--	2	--	2	>0.01
Norther shoveler	--	--	--	--	--
Gadwall	--	*	30	30	0.2
American wigeon	70	200	--	270	2.1
Canvasback	--	15	20	35	0.3
Redhead	--	--	2	2	>0.01
Ring-necked duck	--	10	60	70	0.5
Greater scaup	--	--	25	25	0.2
Scaup spp.	--	2,000	4,700	6,700	51.8
Common goldeneye	--	*	--	--	--
Bufflehead	--	100	300	400	3.1
Ruddy duck	--	1,500	1,000	2,500	19.3
				12,924	99.94
Other water-associated birds					
American coot	100	900	1,200		
Pied-billed grebe		*			
Horned grebe		*			
Bald eagle			1(Adult)		

Table 3

Summary of 1984 and 1985 Waterfowl Observations in the Hydrilla Area: Hunting Creek Bay to Belle Haven Marina

Common Name	Estimated Waterfowl Numbers* Fall 1984	Estimated Waterfowl Numbers* Fall 1985	Percent Increase (+) or Decrease (-)	Estimated Waterfowl Numbers** Fall 1984	Estimated Waterfowl Numbers** Fall 1985	Percent Increase (+) or Decrease (-)
Geese						
Canada goose	150	340		200	300	
Brant	--	--		0	1	
Total (species)	150(1)	340(1)	+126	200(1)	301(2)	+50
Dabbling Ducks						
Wood duck	12	15		7	4	
Green-winged teal	10	392		5	100	
Black duck	30	350		30	50	
Mallard	215	517		200	200	
Northern pintail	72	498		50	100	
Blue-winged teal	64	486		30	200	
Northern shoveler	16	27		11	15	
Gadwall	4	25		6	4	
American wigeon	14	150		20	20	
Total (species)	437(9)	2,455(9)	+462	359(9)	694(9)	+93
Diving Ducks						
Canvasback	54	45		35	3	
Redhead	--	--		2	0	
Ring-necked duck	6	8		10	2	
Greater scaup	30	27		8	4	
Lesser scaup	260	13		300	30	
Goldeneye	0	1		--	--	
Bufflehead	0	57		10	4	
Ruddy duck	400	1,104	500	500		
Oldsquaw	--	--		0	40	
Total (species)	750 (5)	1,255 (7)	+67	865 (7)	583 (7)	-33
Grand total (species)	1,337 (15)	4,050 (17)	+203	1,424 (17)	1,578 (18)	+11

Note: Numbers represent highest daily estimates for the count period.

* Observer, J. Abbott, 29 September-13 November 1984; 22 September-23 November 1985.

** Observer, E. Wiegel, 7 October-10 November 1984; 29 September-13 November 1985.

Table 4

Summary of 1984 and 1985 Shorebird Observations in the Hydrilla Area: Hunting Creek Bay to Belle Haven Marina

Common Name	Estimated Shorebird Numbers* Fall 1984	Fall 1985
Black-bellied plover	4	14
Lesser golden plover	3	38
Semipalmated plover	-	10
Killdeer	30	35
Greater yellowlegs	15	22
Lesser yellowlegs	34	176
Solitary sandpiper	-	3
Spotted sandpiper	-	3
Hudsonian godwit	-	1
Ruddy turnstone	-	4
Red knot	1	1
Sanderling	1	6
Semipalmated sandpiper	12	4
Western sandpiper	2	38
Least sandpiper	10	45
White-rumped sandpiper	3	8
Baird's sandpiper	1	3
Pectoral sandpiper	35	565
Dunlin sandpiper	2	60
Stilt sandpiper	3	50
Buff-brested sandpiper	-	2
Short-billed dowitcher	-	10
Long-billed dowitcher	-	3
Common snipe	-	4
Total (species)	156 (15)	1,105 (24)

* Observer, J. Abbott; numbers represent highest daily estimates for the count period: 2 September-20 October 1984 and 12 September-20 October 1985.

Table 5

Waterfowl Numbers Recorded During Aerial Survey,

25 November 1985

Species	Hunting Creek Bay Dyke Marsh	Broad Creek Bay
Tundra swan	--	1
Canada goose	20	--
Dabbling ducks		
Green-winged teal	120	--
American black duck	510	25
Mallard	575	140
Northern pintail	465	30
Northern shoveler	--	2
Gadwall	90	--
American wigeon	110	20
Subtotal (species)	1,870 (6)	217 (5)
Diving ducks		
Canvasback	85	140
Ring-necked duck	130	--
Scaup spp.	620	1,350
Bufflehead	135	20
Ruddy duck	1,200	--
Subtotal (species)	2,035 (5)	1,510 (3)
Total ducks (species)	3,905 (11)	1,727 (8)
American coot	800	600
Bald eagle	--	1 (adult)

Table 6

Food Habits Analysis

Species	Gizzard Contents	
	Item	Percent by Volume
Mallard (M)*	Hydrilla	60
	Gastropoda	1
Mallard (M)	Hydrilla	100
	Gastropoda	trace
Mallard (M)	Hydrilla	100
	Gastropoda	trace
Mallard (M)	Hydrilla	90
	Polygonum	10
	Plastic	trace
Mallard (M)	Hydrilla	100
	Polygonum	trace
Mallard (F)	Bryozoa	50
	Gastropoda	50
Mallard (F)	Hydrilla	100
Mallard (F)	Hydrilla	100
	Polygonum	trace
	Gastropoda	trace
Mallard (F)	Polygonum	100
	Unknown	trace
Black duck (F)	Hydrilla	100
	Polygonum	trace
Wood duck (F)	Polygonum	100
	Unknown	trace
Canada goose (F)	Graminea	100
	Hydrilla	trace
Coot (F)	Hydrilla	90
	Gastropoda	10

* M = male; F = female.

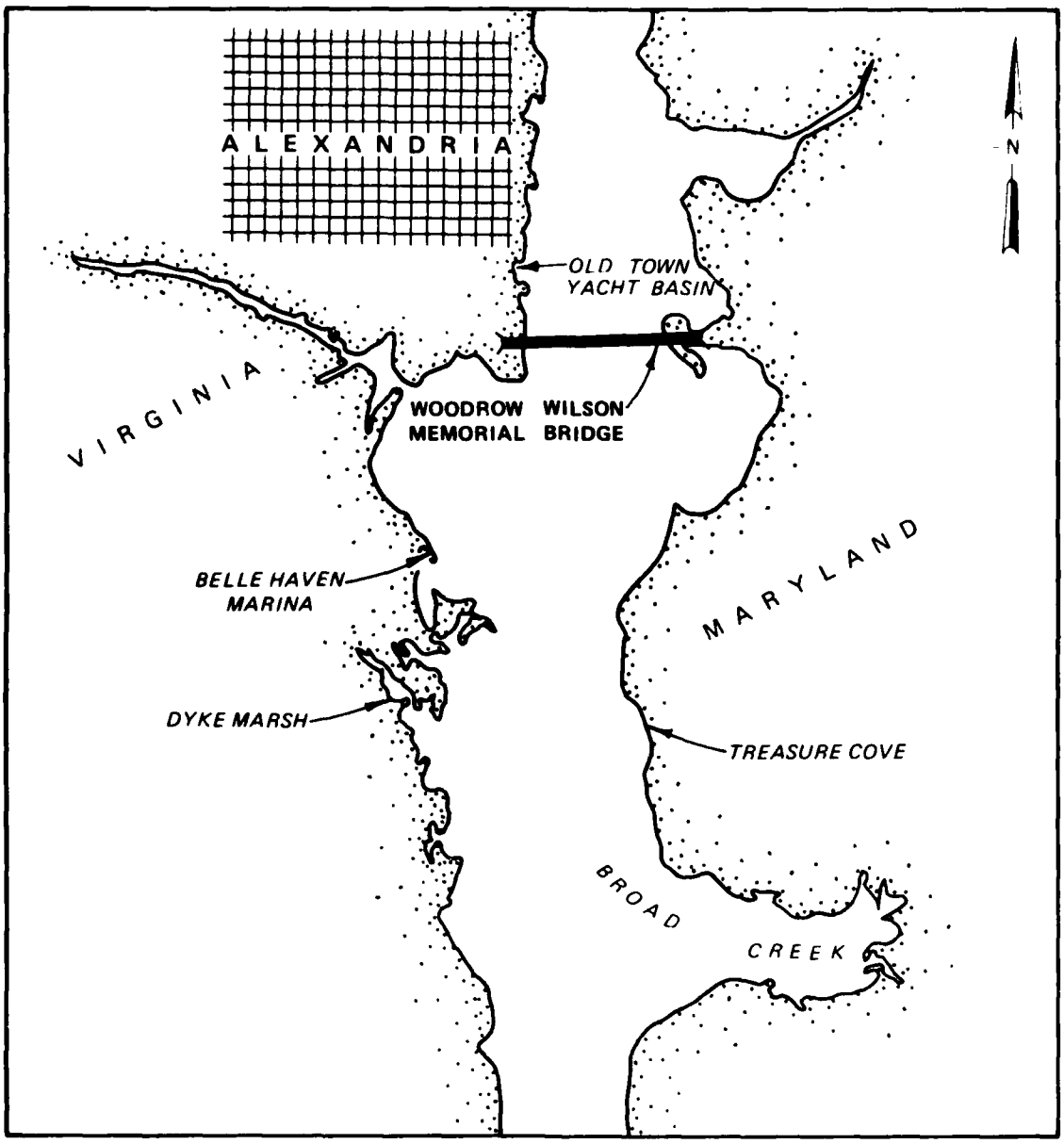


Figure 1. Potomac River study sites

Figure 2. Having decided hydrilla was edible, Canada geese were steady feeders

Figure 3. A pair of canvasbacks and a black duck finding hydrilla in this large trough. The large birds are Australian black swans

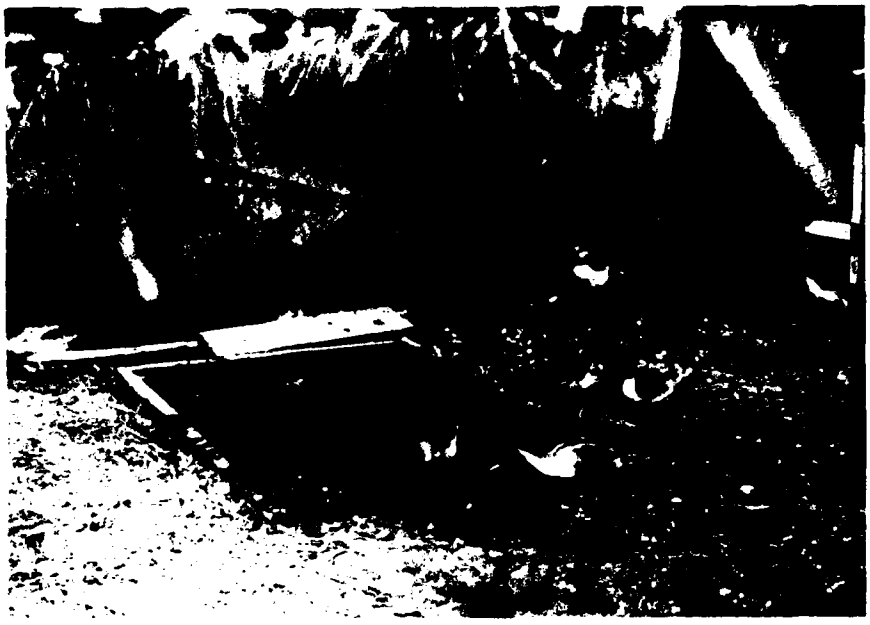


Figure 4. Hydrilla was eaten by pintails, both on the ground and in the water

Figure 5. Shoveler and wigeon feeding in the trough. Snow and blue geese preferred eating off the ground

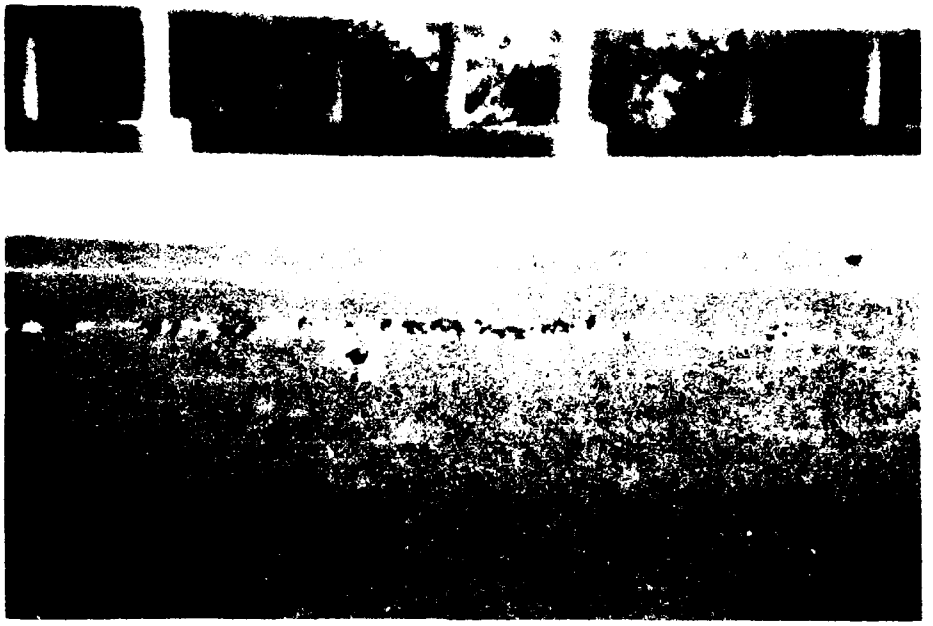


Figure 6. Canada geese feeding in the center of the SAV bed off the mouth of Hunting Creek; Woodrow Wilson bridge in the background

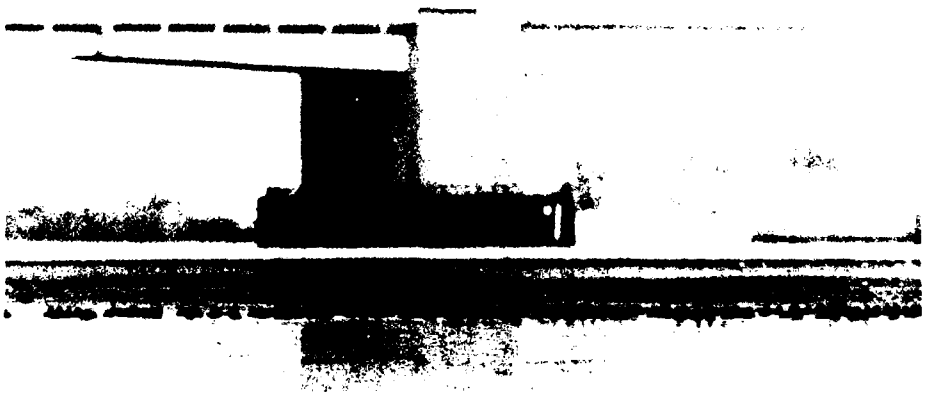


Figure 7. Large groups of feeding coots were very conspicious and much easier to approach than ducks

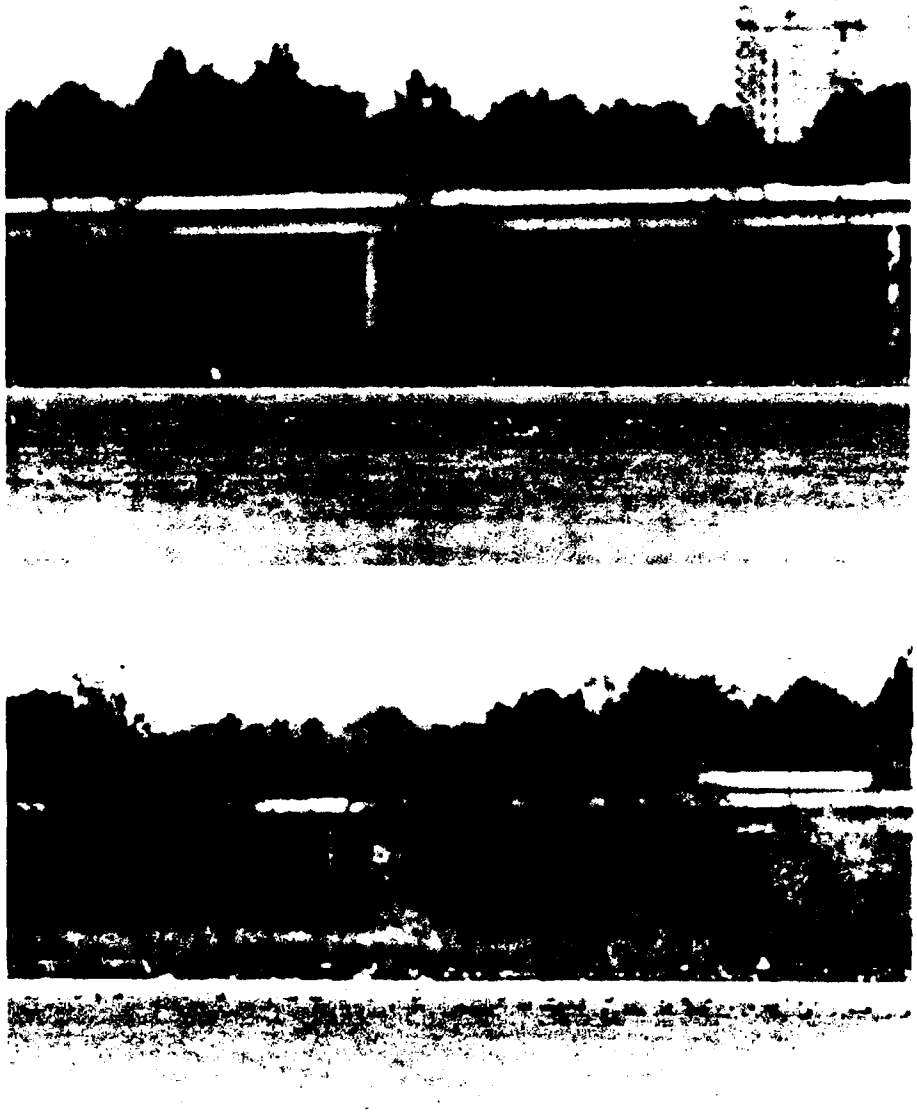


Figure 8. These adjacent photos show waterfowl feeding in a bed of SAV composed primarily of hydrilla. Ducks identified in these photos include mallard, black duck, pintail, wigeon, and gadwall

Figure 9. A flock of birds, primarily coots, feeding on hydrilla at high tide. Hunting Creek bridge visible at about center of photograph

Figure 10. Coots working on a clump of hydrilla floating at the surface

Figure 11. Coots feeding in a hydrilla bed. Bird in the foreground can be seen ingesting a hydrilla fragment

Figure 12. Two drake mallards actively feeding on hydrilla

a. Lesser yellowlegs

b. Pectoral sandpipers

Figure 13. Shorebirds find hydrilla beds excellent feeding areas

Figure 14. Fish-eating birds, such as pied-billed grebes and the double-crested cormorants pictured here, presumably find an ample food supply in channels through and around the hydrilla

Figure 15. Great blue herons were often seen fishing small openings in the hydrilla beds. This one was successful

Appendix A: Common and Scientific Names of Bird Species (Ordered According to the A.O.U. Check List - 1983)

Common Name	Scientific Name
Pied-billed grebe	*Podilymbus podiceps*
Horned grebe	*Podiceps auritus*
Double-crested cormorant	*Phalacrocorax auritus*
Great blue heron	*Ardea herodias*
Great egret	*Casmerodius albus*
Snowy egret	*Egretta thula*
Little blue heron	*Egretta caerulea*
Green-backed heron	*Butorides striatus*
Glossy ibis	*Plegadis falcinellus*
Tundra swan	*Cygnus columbianus*
Brant	*Branta canadensis*
Canada goose	*Branta bernicla*
Wood duck	*Aix sponsa*
Green-winged teal	*Anas crecca*
American black duck	*Anas rubripes*
Mallard	*Anas platyrhynchos*
Northern pintail	*Anas acuta*
Blue-winged teal	*Anas discors*
Northern shoveler	*Anas clypeata*
Gadwall	*Anas strepera*
American wigeon	*Anas americana*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Greater scaup	*Aythya marila*
Lesser scaup	*Anthya affinis*
Common goldeneye	*Bucephala clangula*
Bufflehead	*Bucephala albeola*
Ruddy duck	*Oxyura jamaicensis*
Oldsquaw	*Clangula hyemalis*
Osprey	*Pandion haliaetus*
Bald eagle	*Haliaeetus leucocephalus*
Merlin	*Falco columbarius*
Peregrine falcon	*Falco peregrinus*
Common moorhen	*Gallinula chloropus*
American coot	*Fulica americana*
Black-bellied plover	*Pluvialis squatarola*
Lesser golden plover	*Pluvialis dominica*
Semipalmated plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Greater yellowlegs	*Tringa melanoleuca*
Lesser yellowlegs	*Tringa flavipes*
Solitary sandpiper	*Tringa solitaria*
Spotted sandpiper	*Actitis maculoria*
Hudsonian godwit	*Limosa haemastica*

(Continued)

Common Name	Scientific Name
Ruddy turnstone	*Arenaria interpres*
Red knot	*Calidris canutus*
Sanderling	*Calidris alba*
Semipalmated sandpiper	*Calidris pusilla*
Western sandpiper	*Calidris mauri*
Least sandpiper	*Calidris minutilla*
White-rumped sandpiper	*Calidris fuscicollis*
Baird's sandpiper	*Calidris bairdii*
Pectoral sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Stilt sandpiper	*Calidris himantopus*
Buff-breasted sandpiper	*Tryngites subruficollis*
Short-billed dowitcher	*Limnodromus griseus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Common snipe	*Gallinago gallinago*
Parasitic jaeger	*Stercorarius parasiticus*
Laughing gull	*Larus atricilla*
Bonaparte's gull	*Larus philadelphia*
Ring-billed gull	*Larus delawarensis*
Herring gull	*Larus argentatus*
Lesser black-backed gull	*Larus fuscus*
Great black-backed gull	*Larus marinus*
Caspian tern	*Sterna caspia*
Black tern	*Chlidonias niger*
Black skimmer	*Rynchops niger*
Royal tern	*Sterna maxima*
Forster's tern	*Sterna forsteri*
Belted kingfisher	*Ceryle alcyon*

Appendix B: Waterfowl Food Habits Information*

1. Preliminary analyses of the gullet and gizzard samples of the 13 waterfowl (see Table 6) revealed that much more *Hydrilla verticilla* was consumed by the birds than originally reported. Approximately 85 percent of the gullet food and 72 percent of the gizzard food of the nine mallards (largest sample) was *Hydrilla*. The part of the plant most commonly eaten was the turions (winter buds), but leaves and stems were also commonly found.

2. The black duck, Canada Goose, and coot had also fed on *Hydrilla*, but none was found in the wood duck food material. Other foods commonly eaten by the waterfowl were *Polygonum* spp., Gastropoda, Bryozoa, and Graminea.

3. The following are the findings for each bird.

Mallard Male 5 Sep 85

Gullet		Gizzard	
Hydrilla	40%	Hydrilla	60%
Polygonum	60%	Polygonum	39%
		Gastropoda	1%
		Grit: 4.6 g	
		3.0 cc	

Mallard Male 5 Sep 85

Gullet		Gizzard (15 cc food)	
Hydrilla	100%	Hydrilla	100%
Gastropoda	trace	Gastropoda	trace
		Grit: 6.4 g	
		4.0 cc	

Mallard Female 5 Sep 85

Gullet	Gizzard (3 cc food)	
empty	Bryozoa	50%
	Gastropoda	50%
	Grit: none	

---

* Provided by Dr. M. Perry.

Mallard Female 5 Sep 85

Gullet		Gizzard (12 cc food)	
Hydrilla	100%	Hydrilla	100%
		Grit: 6.4 g	
		3.8 cc	

Mallard Female 31 Oct 85

Gullet		Gizzard (3 cc food)	
empty		Polygonum	100%
		Unknown	trace
		Grit: 2.9 g	
		2.0 cc	

Mallard Male 11 Oct 85

Gullet		Gizzard	
empty		Hydrilla	90%
		Polygonum	10%
		Plastic	trace
		Grit: 4.5 g	
		2.8 cc	

Mallard Male 11 Oct 85

Gullet		Gizzard (6 cc food)	
empty		Hydrilla	90%
		Polygonum	10%
		Plastic	trace
		Grit: 2.0 g	
		1.4 cc	

Mallard Female 31 Oct 85

Gullet		Gizzard (10 cc food)	
empty		Hydrilla	100%
		Polygonum	trace
		Gastropoda	trace
		Grit: 2.3 g	
		1.7 cc	

Mallard Male 11 Oct 85

Gullet

empty

Gizzard (10 cc food)

Hydrilla	100%
Polygonum	trace

Grit: 3.5 g
2.2 cc

Black Duck Female 5 Sep 85

Gullet

Hydrilla	100%

Gizzard (10 cc food)

Hydrilla	100%
Polygonum	trace

Grit: 3.2 g
2.2 cc

Wood Duck Female 5 Sep 85

Gullet

empty

Gizzard (3 cc food)

Polygonum	100%
Unknown	trace

Grit: 2.1 g
1.2 cc

Canada Goose Female 31 Oct 85

Gullet

empty

Gizzard (5 cc food)

Graminea	100%
Hydrilla	trace

Grit: 13.4 g
7.6 cc

Coot Female 31 Oct 85

Gullet

empty

Gizzard (6 cc food)

Hydrilla	90%
Gastropoda	10%

Grit: 7.3 g
4.6 cc

END

8-87

DTIC